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## Review: Goat milk and its nutraceutical properties

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### Abstract

Goats produce about 2% of the world's total annual milk supply. Even some goats are bred for milk only. Goat's milk accounts for 65 percent to 72 percent of all milk consumed worldwide, since goats are easier to keep than cows, and goat milk is a high amount of calories, protein, and lipids. Many people in many places prefer goat milk to cow milk because it is thicker and creamier. In addition to this, goat milk has more nutrients that offer a lot more health benefits such as easy digestion, low risk of milk allergies, and cardiovascular advantages. Magnesium, potassium, calcium, phosphorus, protein, and vitamin A are all abundant in goat milk. It aids in the treatment of health issues including cataracts, certain types of cancer, and measles. Goat milk is not only a specialty beverage, but it can be a better option than cow or plant milk because it has a variety of benefits. In this review, a brief composition of goat milk, and some of its nutraceutical powers are explored.

**Keywords:** Goat milk, nutraceutical food, minerals

### 1. Introduction

Only 2% of goat's milk is processed worldwide <sup>[1]</sup>. However, the use of goat's milk is effective for human well-being and it highly contributes to the economy as well as the nutritional need. Due to qualities such as high protein and fat digestibility, buffering capacity, alkalinity, and some therapeutic potential in pharmaceuticals and foods, goat milk may be preferable to cow milk and human milk. Goat milk can be more advantageous than cow milk and human milk due to its properties like high digestibility of protein and fat, alkalinity, buffering capacity, and certain therapeutic values in medicines and human beings <sup>[1]</sup>. People can replace the external supplements with goat milk as it is highly rich in minerals and vitamins. Zenebe *et al.*, (2014) <sup>[27]</sup> concluded that goat milk can be an ideal substitute for cow milk and human milk. Although human milk is a better option for infants in terms of nutritional and immunological view, breastfeeding may break off at an early stage due to several health conditions <sup>[2]</sup>. Hence goat milk can be used as an alternative way of breastfeeding. Goat milk is recommended for infants, old and convalescent people. The demand for goat milk has arisen mainly due to the affliction of people from cow milk allergies and other gastrointestinal ailments. Although goat milk has high nutritional and therapeutic properties, it carries less value in the Indian market system <sup>[3]</sup>. Goat farming is considered a supreme part of many areas of the country. It is well organized in western countries like France, Greece, Italy, and Spain <sup>[4, 5]</sup>. Goat milk contains a modest, well-emulsified fat globule, due to which the cream will stay in suspension for a longer time than cow milk; hence, it does not need to be homogenized. Apart from being a good source of potassium, calcium, and phosphorus, goat milk has several other health benefits, which are investigated in this review.

### 2. Nutritional Profile of Goat milk

#### 2.1 Basic Composition

The compositions of goat milk and cow milk are very consistent to each other. Camel milk, however, has more protein, fat, and ash content than cow milk, as well as less lactose. Total casein is a little less in goat milk than in cow milk <sup>[6, 7]</sup>, but nonprotein nitrogen is higher. The Caprine milk comprises of total solids 12.2%, fat 3.8%, protein 3.5%, lactose 4.1%, and ash 0.8% (Table 1).

**Table 1:** Concentrations (per 100 g) of Basic Nutrients, Vitamins, and Minerals in Goat Milk in comparison with Cow and Human Milks

Constituents	Goat	Cow	Human
<b>Basic nutrients</b>			
Fat (g)	3.8	3.6	4.0
Protein (g)	3.5	3.3	1.2
Lactose (g)	4.1	4.6	6.9
Ash (g)	0.8	0.7	0.2
Total solids (g)	12.2	12.3	12.3
Calories (Cal)	70.0	69.0	68.0
<b>Minerals</b>			
Ca (mg)	134.0	122.0	33.0
P (mg)	141.0	119.0	43.0
Mg (mg)	16.0	12.0	4.0
K (mg)	181.0	152.0	55.0
Na (mg)	41.0	58.0	15.0
Cl (mg)	150.0	100.0	60.0
S (mg)	2.89	-	-
Fe (mg)	0.07	0.08	0.20
Cu (mg)	0.05	0.06	0.06
Mn (mg)	0.032	0.02	0.07
Zn (mg)	0.56	0.53	0.38
I (mg)	0.022	0.021	0.007
Se ( $\mu$ g)	1.33	0.96	1.52
<b>Vitamins</b>			
Vitamin A (I.U.)	185.0	126.0	190
Vitamin D (I.U.)	2.3	2.0	1.4
Thiamine (mg)	0.068	0.045	0.017
Riboflavin (mg)	0.21	0.16	0.02
Niacin (mg)	0.27	0.08	0.17
Pantothenic acid (mg)	0.31	0.32	0.20
Vitamin B6 (mg)	0.046	0.042	0.011
Folic acid ( $\mu$ g)	1.0	5.0	5.5
Biotin ( $\mu$ g)	1.5	2.0	0.4
Vitamin B12	0.065	0.375	0.03
Vitamin C(mg)	1.29	0.94	5.00

Source: [8] & [9], & [10]

## 2.2 Lipids

In terms of the composition of lipids and properties, fat globules from goat milk and cow milk are identical. But agglutinin is absent in goat's milk [9]. Park (2010) reported that the average diameter of fat globules as seen in goat, cow, buffalo, and sheep milk are 3.49, 4.55, 5.92, and 3.30 $\mu$ m, respectively.

It is found that goat milk is three times higher in fatty acids than cow's milk, i.e. C8, C10, and C12. Goat milk is much higher in value than cow milk concerning the free lipids [11, 12].

## 2.3 Proteins

The protein constituents in goat milk and cow milk are alike effectively. The protein part of goat milk holds important physical properties as well as health benefits. Goat milk's protein fragments are spotted and differentiated by the presence of casein micelles, bioactive peptides, amino acids, nucleotides, and nucleosides [2, 13].

Protein fractions are blended with the composition of casein and whey proteins, both of which are found to have virtual similarities in goat milk and cow milk [3, 14]. However, they slightly differ in the constructions of elements. The amount of  $\alpha$ s-casein is less in goat milk than in cow milk,  $\beta$ -casein fractions higher and the number of k-casein fractions is

equal to that of cow milk.  $\alpha$ s-casein is the main protein found in cow milk whereas the main protein factor found in goat's milk is  $\beta$ -casein (Lad *et al.* 2017). Casein micelles in goat milk dominate in higher  $\beta$ -casein solubilization, high amount of phosphorus and calcium, and low stability of heat, and hence differs from cow milk [15, 16].

## 2.4 Carbohydrates

The principal carbohydrate found in goat milk is lactose [17]. Lactose is a sugar combination of glucose and galactose, joined together. The body uses a natural enzyme called lactase to break lactose into these sugars. This major carbohydrate lactose holds 0.2-0.5% in goat milk, which is slightly less than cow milk [18]. Because of the pre-biotic and anti-infective properties that it carries, goat milk can be a beneficiary supplement in human nutrition [19].

Oligosaccharides, glycolipids, glycoproteins, and nucleotides are some other carbohydrates that are found in goat milk in minor amounts. Cow milk has a subsidiary level of monosaccharides and oligosaccharides.

## 2.5 Minerals

Goat milk has a greater mineral content than cow milk and human milk, ranging from 0.70 to 0.85 percent [19]. Human milk contains only a quarter to a sixth of the minerals found in goat milk. Goat milk has roughly 134 mg of calcium and 141 mg of phosphorus per 100 g (Table 1). Comparatively, minerals are found abundant in goat milk. Calcium, Phosphorus, Potassium, Magnesium, and chlorine but sodium and sulfur content are lower than in cow milk (Park, 2010). Goat milk has more zinc and iodine, and less iron content than human milk. Simultaneously goat milk bears high bioavailability of iron than cow milk as it contains high nucleotide fractions and hence this promotes better absorption in the human gut [21]. Goat milk and human milk possess a high amount of Selenium than cow milk [3]. However, the degree of hydration in goat milk is lower and has a relationship between mineralization of the micelle and its hydration which is the inverse [22].

## 2.6 Vitamins

Goat milk is an excellent source of vitamins. Similar to human milk, it contains Vitamin A, which is important for innate and adaptive immune responses as well as good antibody formation. It is rich in Vitamin B as well but due to the conversion of  $\beta$ -carotene into retinol, goat lacks  $\beta$ -carotene in its milk (18,21). This is the reason goat milk is whiter than cow milk. Goat milk has an excessive amount of Vitamin B, i.e., thiamine, riboflavin, and pantothenate which are very important for infants, and hence it can solely be dependent upon goat milk for infancy and these minerals and vitamins can fully gratify the infants' obligation.

## 3. Health benefits of Goat milk

### 3.1 Prebiotics intake

Prebiotics are nutrients that are found in the body's gastrointestinal tract, promoting the growth of beneficial gut bacteria and helping in the prevention of pathogenic bacteria. They are carbohydrates that the body finds difficult to digest, therefore they end up in the lower digestive tract, where they aid in the growth of beneficial bacteria. Boehm and Stahl (2007) concluded that oligosaccharides in human milk, due to their prebiotic and anti-infective

property, are beneficial components. The amount of oligosaccharides in goat milk is higher than in human and cow milk. A beneficial bacterium i.e., *Bifidobacteria*, found in the intestine is highly in the account of these oligosaccharides<sup>[3]</sup>; <sup>[23]</sup>. *Bifidobacteria* are found to deploy numerous health benefits for human health which include immune stimulation, prevention of pathogenic infections, anti-carcinogenic activity, and cholesterol-lowering activity. Lactose maldigestion is also improved with the help of this bacteria<sup>[24]</sup>. The number of oligosaccharides contained in goat milk typically ranges between 250 to 300 mg/l, which is 4-5 times higher than what cow milk contains<sup>[25]</sup>. It is shown that intestinal inflammation can be reduced and colitis in animals can be recovered by the oligosaccharides present in goat's milk<sup>[19]</sup>.

### 3.2 Digestibility

The fats and proteins in goat milk are easily digestible because the fat globule size is smaller than in cow milk and the protein composition is such that it forms a softer curd and allows digestive health and comfort<sup>[3]</sup>. Digestion of goat milk becomes easier and faster because of the contribution of short and medium-chain fatty acids. The portal vein directly takes up the molecules for digestion and therefore, for absorption micelle formation is not required<sup>[26]</sup>.

### 3.3 Antimicrobial Property

Since goat milk has the property of easy digestion, the gastric enzyme pepsin forms peptides that possess antimicrobial nature against gram-negative bacteria<sup>[27]</sup>; <sup>[28]</sup>. The phenomenon of fermentation participates well in the characteristic of antimicrobial essence. Antimicrobial activity against *Serratia marcescens* is deftly exhibited by fermented goat milk than fermented cow milk<sup>[29]</sup>. Goat milk can fight against innumerable bacteria since it contains highly rich proteins. Goat milk contains a protein, Lactoperoxidase (LP), which has acted effectively against a slew of bacteria that causes typhoid (*Salmonella typhi*), cholera (*Vibrio cholera*), dysentery (*Shigella dysenteriae*), pneumonia (*Klebsiella pneumoniae*), and food poisoning (*Staphylococcus aureus*) (Yadav *et al.*, 2016).

### 3.4 Anticarcinogenic activity

There is a high content of conjugated linoleic acid (CLA) in goat milk in which the ant carcinogenic properties are found against colon and mammary cancer in both animal and human melanoma, breast cancer, and colorectal models *in vitro*<sup>[30]</sup>. The tumor development inhibiting CLA's mechanism is still unknown, however, fermented goat milk has been linked to disruption of eicosanoid-dependent cell signaling systems, anti-oxidative properties, and disruption of estrogens receptor-mediated functions<sup>[31]</sup>.

### 4. Conclusion

Researchers suggest that goat milk can be a better supplement than cow milk for people suffering from cow milk allergies and anemic patients. Goat milk is richer in protein as compared to standard soy milk, nut milk, or cow milk. Goat milk protein is more easily digested, implying that our bodies can absorb it more readily. Notably, goat milk also contains more protein than almond milk or rice milk. Because of the nutraceutical and functional properties of goat milk, it yields a high value in the market system and

has increased its demand. It is a healthier option for infants and growing children. Folic acid, which is deficient in goat's milk, should be exercised with the goat milk products.

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